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Exposure and fungous Diseases.*

BY BYRON D. HALSTED.

Exposure has something to do with the attack of parasitic fungi and this may be of at least two kinds—to the elements—sunshine, air, moisture, etc., and to the germs of the disease. Both of these sets of conditions work together for the production of infection.

Some striking illustrations of the value of exposure to the germs in the success of inoculation have come under the writer's notice within the past year. Attention is directed to the infestation of a young growth of asparagus to the rust fungus, *Puccinia asparagi* DC. On September sixth, while inspecting asparagus fields in Gloucester county, New Jersey, the writer came to a field with quite an unusual green appearance, nearly all the fields being brown and lifeless so far as the brush was concerned, having been killed by the remarkable ravages of the rust fungus. The field in question had been cut over and the very rusty brush removed about five weeks before, with the hope that the new growth might escape the ravages of the *Puccinia.* At the date of the inspection the brush was about hip high and showing the rust only upon one side of each plant. So strikingly one-sided was the output of the rust sori that one could scarcely fail to observe it. Every main stem was almost completely covered with the rust upon one side, while the opposite bore almost no spots. It was also noticed that this rusted side varied somewhat at different ends of the long field, and at all points was at right angles to lines drawn from an old and very badly rusted bed of asparagus that stood with its end towards the broad side of the field in question and about forty rods away.

This observation teaches something concerning the rapidity of the development of the rust fungus. As the brush must needs have been developed to some extent before the uredospores could have alighted upon them, and as also it is fair to judge that many of the sori upon the plants were fully ten days old, therefore not more than two weeks might have elapsed from the time when the spores came to the asparagus plants to that when sori were giving off their spores. The season was unusual, July being a very rainy month, and the long wet period continued into August, followed by hot moist weather particularly favorable for the development of fungi.

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That the source of infection was the old asparagus bed is beyond question. About midway between the two beds stands a house and a few trees around it, and it was observed that there was less rust upon that portion of the new bed that was in line with this house and the old bed. In short, there was a barrier between the old bed and the new that interfered with the free passage of the spores. When the surface of the rusted stems of the old bed were dry and the winds blew from it towards the new bed, the spores were doubtless carried in great abundance, and these spores alighting upon the tender stems of the young shoots, encouraged by hot dewy nights, quickly germinated and rusted the plants. There is no reason to doubt that some of the rust spores were carried by the winds to long distances and infected plants miles from where they were produced.

A single other instance may be mentioned in passing that appears to have escaped previous observation. The hollyhock rust (*Puccinia malvacearum* Mont.) is very abundant in some gardens in New Jersey. The normal place for the production of the sori of this rust is upon the under surface of the leaf blades, but in very badly infested plants the veins and petioles of the leaves and even the stem of the hollyhock bear the rust spots. The point of observation is this, that when the petioles are rusted the disease is confined almost entirely to the upper side.

It is possible that here there may be a working together of the exposure to the germs and the favorable meteorological conditions for the development of the spores.

As in the asparagus rust the infection is rapid, but here it is by means of sporidia and not by uredospores as in the *Puccinia asparagi*. These sporidia are borne abundantly by the leaves above and might naturally drop upon the upper surface of the petioles, the hairiness of which would tend to hold them. It is possible that the warmth of the spring sun upon the moist upper surface furnishes the conditions that favor the growth of the sporids.

An examination of the stems, some of which were badly rusted, showed that the side towards the center of the group of stalks were the most affected.

This leads naturally to a study that was made of bacteriosis in beans briefly mentioned with an engraving in Mycological Notes in the June issue of the BULLETIN.

"The rows ran nearly north and south and upon the east side of the plants there was but a small amount of the bacteriosis (*Bacillus phaseoli* Sm.) to be seen, while upon the west side nearly every pod of the green flageolet variety was more or less blotched, many of them literally covered with the bacterial ulcers, which were in many instances of an amber color, due to the multitude of the germs of the bacillus that had collected in a layer upon the surface."

Fully nine tenths of all the blotches were upon the western sides of the pods and about two fifths of all the pods of the variety in question were badly affected.

Strong winds upon the 17th and 20th of September bent the plants to the southeast, from which they did not fully recover. As a result, at the time the above observations were made, October 5th, the plants all leaned several degrees from the perpendicular and some of the pods were likewise tilted. In short, the foliage of the plants hung chiefly upon the eastern side of the row and had done so for between two and three weeks, and therefore one side of each pod was more exposed than the other, and that exposure was, speaking generally, in the direction of the four o'clock sun.

It had been previously observed that the leaves of the plants under consideration were badly blighted for weeks before the pods became noticeably injured, and it is not unlikely that the germs were carried from the diseased leaves to the pods by the dripping dews, in which case the side that was slightly inclined upward on account of the slanting posture of the plants would receive a more generous supply of the germs than the more protected underside.

It is possible that the bending of the plants so exposed the pods that they became more or less injured by the sun and thus provided more favorable conditions for the development of the bacteria. The warmth of the sunny side may have been sufficient to make the difference observed.

All the circumstances may have combined to bring about the results that were so strikingly evident. The bending of the plants and the swinging of the foliage to the eastward, the inclining of the pods and the exposing of the upper surface, that would naturally receive the drips from the diseased leaves, the autumn sun during the afternoon, either adding the required warmth for the germs or partially scalding the side most exposed and thus render the tissues more susceptible to attack are all still open questions.

One cannot but wonder what the result might have been had the plants been pressed back into place after the storm or a portion of the plot been shaded or even if the rows had run east and west instead of north and south.

If spores pass through the air, as is the common belief, there is nothing particularly obscure in the observations in the asparagus field, and the hollyhock rust upon the upper side of the petiole is only an instance of the drips from an infested leaf naturally reaching the nearest side, while the bacteriosis of the bean deals with the unequal conditions for growth upon different sides of the bean pod due to more favorable ones obtaining upon the one than the other. Doubtless many other instances like the ones cited may be found when one is upon the watch for them.

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